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BEHAVIOR OF THREE SPECIES OF THE FAMILY ARTEDIDRACONIDAE (PISCES, NOTOTHENIOIDEI), WITH REFERENCE TO FEEDING

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Abstract: Feeding behavior of 3 species of the Artedidraconidae, *Artedidraco skottsbergi*, *Histiodraco velifer* and *Pogonophryne marmorata* was observed in a laboratory. *H. velifer* and *P. marmorata* responded to touching their mental barbel with fresh krill and their feeding behavior seemed to be evoked with the stimuli received by the barbel in the light condition. The observed motion of the barbel likely indicated that the barbel of the two species of artedidraconids functioned as an antenna or a sensor to perceive prey organisms. *A. skottsbergi* did not show any action responding to the prey supplied in a tank.

1. Introduction

Fishes of the family Artedidraconidae, which are composed of 4 genera and 24 species (EAKIN, 1990), are characterized by having a mental barbel at the distal tip of the lower jaw. The mental barbel has hitherto been thought to function either as an organ of taste or as a lure. Artedidraconid fishes are not an extremely rare group, but it is also known as a fact that a large number of artedidraconids are not caught in a catch. Accordingly, their biology and ecology including feeding behavior has not been studied well. The record of the locomotion, feeding behavior and function of the mental barbel of *Histiodraco velifer* by JANSSEN *et al.* (1993) is a useful basis for studies of the artedidraconid biology.

During the 34th Japanese Antarctic Research Expedition (JARE-34) (1992/93), 6 specimens of the Artedidraconidae consisting of one *H. velifer*, one *Pogonophryne marmorata*, one *Artedidraco loennbergi*, and three *Artedidraco skottsbergi* were collected with beam trawls from three sites as shown in Table 1. Three of 6 fishes caught were in good condition except for one *A. loennbergi* and two *A. skottsbergi* specimens. They were kept in a tank on board the icebreaker SHIRASE. Some observations of the locomotion and feeding behavior of these fishes were carried out, focusing on the function of the mental barbel. In this paper, we describe the results observed to increase knowledge of the ecology of the Artedidraconidae, and compare our results with those of JANSSEN *et al.* (1993).

Table 1. Measurements and collection data of artedidraconid fishes collected during JARE-34.

Species	Measurements		Collection data		
	Standard length(SL)	Barbel length	Date	Position	Depth
*Artedidraco skottsbergi**	64.0 mm	2.5 mm (3.9% of SL)	10.II.1993	68°41.6′ S, 38°43.8′ E	291 m
A. skottsbergi	49.3 mm	2.3 mm (4.7% of SL)	20.II.1993	66°41.3′ S, 48°19.9′ E	203 m
*A. skottsbergi**	50.7 mm	1.9 mm (3.7% of SL)	3.III.1993	67°08.8′ S, 75°17.1′ E	398 m
*Artedidraco loennbergi**	73.3 mm	3.9 mm (5.3% of SL)	3.III.1993	67°08.8′ S, 75°17.1′ E	398 m
Histiodraco velifer	112 mm	26.6 mm (23.8% of SL)	20.II.1993	66°27.9′ S, 48°32.6′ E	842 m
Pogonophryne marmorata	185 mm	21.8 mm (11.8% of SL)	3.III.1993	67°07.4′ S, 75°15.2′ E	396 m

*not used for the present study.

2. Materials and Methods

One individual of each species of *Artedidraco skottsbergi, Histiodraco velifer* and *Pogonophryne marmorata*, as shown in Table 1, were used for the present study. These fishes were collected during the JARE-34 cruise of the icebreaker SHIRASE (17600 tons) in 1993 with either 2.0 or 3.0 m beam trawls. Just after collecting fishes, they were sorted out and transferred into a well aerated tank on board.

The observation was started at least 6 days after their capture to allow for adjustment of physiological conditions. Observations were made in a transparent PVC tank (80×50×50 cm deep) set in a cold-storage room. Room temperature was kept between about −2°C and 1°C. The water in the tank was circulated by using an electric pump with filter. Their behavior was watched with a Sony CCD-TR75 video camera recorder under usual light condition. To induce feeding behavior, live gammarid amphipods and copepods, and fresh Antarctic krill, *Euphausia superba* as a whole, were given as bait.

3. Results

3.1. Artedidraco skottsbergi

No behavioral observation has been reported on this species. During our experiment, the response to prey and feeding action of *A. skottsbergi* were not observed. Small live amphipods and copepods, krill chips and a fine wire failed to elicit feeding behavior. The mental barbel of *A. skottsbergi* was very short (4.7% of SL; Table 1) and *A. skottsbergi* was not observed to lift up its barbel. It was always drooping from the anterior tip of the lower jaw (Fig. 1a). *A. skottsbergi* usually erected the small first dorsal fin, but did not erect its second dorsal fin during the observation. In the tank, this species occasionally swam by wriggling its tail and was not observed to walk. *H. velifer* and *P. marmorata* crawled on the bottom by rowing pelvic fins as mentioned below.

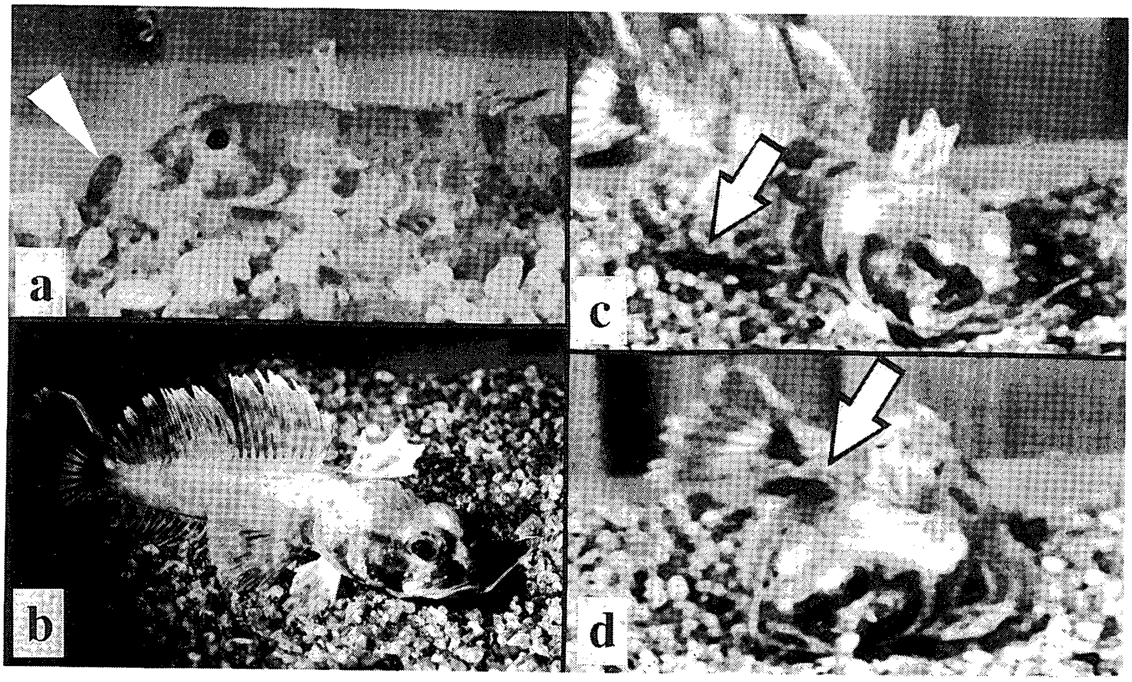

Fig. 1. Artedidraco skottsbergi *(a) and* Histiodraco velifer *(b–d) in a tank. Figure 1a, c and d are VTR frame-to-print conversions. a,* A. skottsbergi, *with first dorsal fin erected and inclined anteriorly; b,* H. velifer, *extending the mental barbel at an angle up from the bottom; c, just before recognizing a living amphipod as prey; d, turning its head to prey, with its mental barbel being farther erected. Arrows indicate preys (a, copepod; c and d, gammarid).*

3.2. Histiodraco velifer

The mental barbel of *H. velifer* was very long (23.8% of SL; Table 1) and usually extended at an angle up from the bottom (Fig. 1b). The first and second dorsal fins were erected and the erected first dorsal fin was inclined anteriorly. *H. velifer* responded to touching the barbel with krill and the fish usually attacked the bait after 2 to 8 subsequent touchings. Based on the response to touching of different parts of the barbel, it appeared that the most effective part to elicit an attacking motion was the medial part of the barbel. Successive touching of the distal part of the barbel sometimes made the fish move its head away from the bait. It is clear that the sensitivity to the stimulus was different in different parts of the barbel. When the fish took the diet, an attack always resulted in the mental barbel being inhaled; after a few seconds it was exhaled.

It was observed that an actively swimming gammarid discharged as a live bait was predated by *H. velifer* just after touching the "unwaggling" barbel. When the amphipod happened to touch the body of the fish, *H. velifer* erected its barbel and turned its head to the prey (Fig. 1c, d). When the prey touched the barbel, *H. velifer* attacked and ate the prey at lightning speed. During the present observation, *H. velifer* did not show motion toward the live amphipod such as waving its mental barbel.

Our results on the locomotion of *H. velifer* almost agreed with those of Janssen *et al.* (1993). This fish moved on the bottom by rowing its pelvic fins. The left and right pelvic fins were extended anteriorly at the same time and also simultaneously pushed the bottom to shift its body forward.

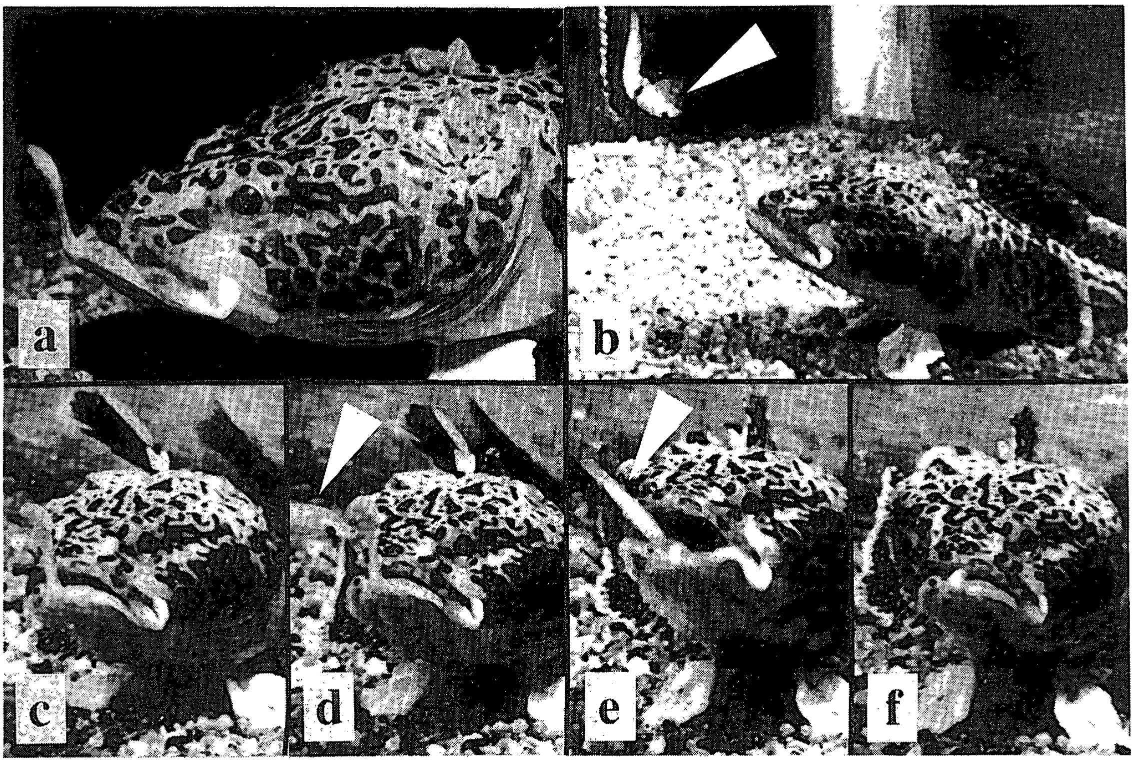

Fig. 2. Pogonophryne marmorata *in a tank. a, the mental barbel extending at almost a right angle up from the bottom. b–f are selected VTR frame-to-print conversions of a single feeding event: b, aiming at a krill; c, frontal view of aiming posture; d, mental barbel touched by a krill; e, prey being drawn toward oral cavity with the barbel; f, barbel completely inhaled just after feeding. Arrows indicate* Euphausia superba.

3.3. Pogonophryne marmorata

Before this observation, there has been no description of the behavior of *Pogonophryne* species. *P. marmorata* usually kept its mental barbel extended at almost a right angle up from the bottom of a tank (Fig. 2a). When *P. marmorata* displayed interest in the prey, flesh krill, the fish reared its head. At that time the distance from the tip of the mental barbel to the bottom reached more than 10 cm (Fig. 2b).

After 10 or fewer gentle touches of the barbel with a krill, the fish struck the prey. As in the case of *H. velifer*, the sensitivity of the barbel to the stimulus by prey varied at different parts of the barbel. The most effective position to elicit an attack was the base of the terminal expansion of the barbel (Fig. 2c, d). *P. marmorata* also inhaled its mental barbel when the fish attacked the prey, and then exhaled the barbel after swallowing the bait (Fig. 2e, f).

The mode of locomotion of *P. marmorata* almost agreed with that of *H. velifer*. This fish retracted both pelvic fins simultaneously and pushed the bottom to shift its body forward. Then *P. marmorata* extended its pelvic fins anteriorly for the next stroke.

4. Discussion

Feeding behavior of the artedidraconid fishes was not known until Janssen and his coworkers described that of *Histiodraco velifer* (Janssen *et al.*, 1993). In the present study, the feeding behavior of two other species of the Artedidraconidae, *Artedidraco skottsbergi* and *Pogonophryne marmorata*, has been newly reported. Also new information on the behavior of *H. velifer* has been added.

Although the function of the mental barbel of *A. skottsbergi* is not clear, it seems that *A. skottsbergi* does not use its barbel so actively, judging from its size and shape, and also general behavior in the tank. This species did not show the walking posture observed in *H. velifer* and *P. marmorata*, and occasionally swam to move by wriggling its tail. Compared with the body shapes of *Histiodraco* and *Pogonophryne*, that of *Artedidraco* was more compressed. Consequently, it was probable that the body form of *Artedidraco* caused its locomotion to vary from other artedidraconids having depressed bodies.

JANSSEN *et al.* (1993) concluded that the mental barbel of *H. velifer* functioned as a lure, mainly based on the results of pinching experiment of the barbel. They considered that pinching implied hitting by other animals. In addition, they also suggested that the function of the mental barbel of *H. velifer* was convergent with that of the Antennariidae.

During our experiments, the behavior of wagging the mental barbel was never recognized. As far as observed in this work, it is concluded that *H. velifer* do not use their barbel as fishing lure like the antennariid fishes. The fact that the stomach contents of one *H. velifer* collected from the Ross Sea, which contained gammarids and polychaetes (IWAMI, unpublished), and the newly known feeding behavior of the Artedidraconidae do not support the idea proposed by JANSSEN *et al.* (1993) that the shape and motion of the barbel are similar to those of an amphipod and therefore the barbel functions as a lure.

MILLER (1993) recognized some fragments of polychaetes in one Endeavour specimen of *H. velifer*. In the first place, amphipods and polychaetes are known to be common food items of the artedidraconid fishes (TARGETT, 1981; WYANSKI and TARGETT, 1981; DANIELS, 1982). Generally speaking, amphipods do not attack to bite other amphipods positively, and the same is true of polychaetes. Consequently, the barbel similar to the shape of amphipods is thought not to be useful to attract other amphipods and polychaetes as prey. In the case of a piscivorous species, such as *Pogonophryne dolichobranchiata* (WYANSKI and TARGETT, 1981), the shape of the barbel resembling an amphipod may be effective to attract the prey. The shape of the mental barbel of *P. dolichobranchiata*, however, is not similar to that of amphipods. This also does not agree with the suggestion made by JANSSEN *et al.* (1993).

Most species of the Artedidraconidae are found from depths deeper than *ca.* 200 m (EAKIN, 1990; EASTMAN, 1993). In those habitats, the shape and motion of the barbel without luminous organs may be hard for prey organisms to detect. The movement and function of the barbel of the Artedidraconidae, therefore, are not comparable with those of the illicial apparatus of shallow water frogfishes, the Antennariidae, or of the chin barbels of the Melanostomiatidae with luminous organs.

It was observed that *H. velifer* turned its head to prey when an amphipod encountered the fish. This behavior showed that *H. velifer* can detect prey by use of visual cues as well as lateral line cues at least in the light condition. JANSSEN *et al.* (1993) noted that the visual presence of the experimenter prevented the fish from eliciting a strike. They also remarked that the fish responded to pinching its barbel but not touching it with meat. *H. velifer* examined in the present study responded to touching the barbel with krill, and always attacked the prey in the light condition. If there is no tastebud on the barbel as suggested by JANSSEN *et al.* (1993), it can be concluded that the tactile sensibility of the mental barbel is extremely high and a slight stimulus to the barbel can elicit feeding behavior. Behavior of reared *P. marmorata* was observed for the first time, while its feeding behavior and locomotion were very similar to those of *H. velifer* observed by us.

The present observations indicate that *H. velifer* and *P. marmorata* possibly detect the presence and position of prey by the mental barbel rather than using it as a lure. This hypothesis is supported by the fact that the middle part of the barbel is more effective than the distal part for eliciting the strike. The mental barbel of the artedidraconid fish works as a trigger of a ratter, *e.g.* prey sensor. The fish was not observed to actually use its barbel as a lure. The mental barbel of artedidraconid fishes is not an example of aggressive mimicry as in the case of the illicial apparatus of the Antennariidae shown by PIESCH and GROBECKER (1987).

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